

Arrangement and system for a dental replacement component,

5 The present invention relates, inter alia, to an arrangement for a dental replacement component, which can constitute all or part of a dental bridge, tooth preparation, etc., and which can be given a color corresponding to the area surrounding the replacement component in the patient's mouth (dentine, gums, 10 teeth). The replacement component has a reinforcing element which comprises carbon fiber wires which are arranged in one or more carbon fiber hoses and can be held together by means of hardenable substance so as to form a homogeneous part of the reinforcing element.

15 The invention also relates to a system for producing a replacement component of this kind.

20 It is already known to use reinforcing elements comprising carbon fiber material, and, on this point, reference may be made to Swedish patent SE 457 691 and to Swedish patent applications 0004883-5, 0203497-3 and 0203897-4.

25 In the production of a replacement component of the type in question, it is important to be able to provide colors which match the patient's remaining teeth, jaw bone, gums, etc. The use of carbon fiber as reinforcing element gives good results from the point of view of 30 strength. At the same time, however, there is a problem with the carbon fiber's dark color, which has a strong capacity to show through and which is difficult to conceal with opaque covering colors in the form of pink or white.

35 There is therefore a great need to be able to make the reinforcing element from fibers of another color. The problem is that there is no alternative fiber available on the market with the strength and other physical

properties of carbon fiber.

The present invention aims to solve this problem and proposes a reinforcing element comprising a core or  
5 inner part which is still made of carbon fiber, and a fiber arrangement which lies on the outside of this and is more suitable than the carbon fiber in terms of its color.

10 The feature which can principally be regarded as characterizing an arrangement according to the invention is that the carbon fiber part, at least in its portion or portions directed toward the surrounding area, supports or is provided with additional fiber  
15 material with a color which better matches said coloring than does the carbon fiber.

The additional fiber material can have a tube shape and can enclose all or said portion/portions of the carbon  
20 fiber. Besides covering the dark color of the carbon fiber, the additional fiber material can, if so desired, also increase the stiffness and/or strength of the homogeneous carbon fiber part. The additional fiber material can consist of aluminum oxide or of para-  
25 aramid. In a preferred embodiment, the layer or thickness of the additional fiber material will be 2-5% of the thickness or diameter of the reinforcing element. Further embodiments of the novel arrangement are set out in the attached dependent claims relating  
30 to the arrangement.

The feature which can principally be regarded as characterizing a system according to the invention is that identification equipment is designed to identify  
35 the treatment situation on the patient and to transmit information to computer equipment which, as a function of said information and through interaction with a user, is intended to permit display, on screen, of the replacement component and of a reinforcing element

included in said component and having a core or inner part of carbon fiber, and fibers completely or partially covering the core or inner part and made of a material, for example aluminum oxide or para-aramid, which has a color better matching said coloring than does the carbon fiber, and that equipment involving considerable manual input and/or substantially fully automated equipment (PROCERA®) is arranged to take part in production of the reinforcing element on the basis of empirical data concerning the core and the fiber covering the latter, for example with the aid of data on diameters, thicknesses, qualities, color, relations between the diameters and thicknesses, etc.

By means of what has been proposed above, it is possible to obtain what could be regarded as a hybrid. The carbon fiber is used as reinforcement for production of dental bridges on implants or prepared teeth. The dark color of the carbon fiber is not easy to change, which generally is a considerable disadvantage in the production of dental bridges. The fiber therefore has to be painted with a covering color (pink or white) depending on whether the aim is to conceal it against the gum or the teeth. A desire to be able to use a white fiber has therefore been expressed. The aluminum oxide fiber is white in color and is therefore widely accepted in this application. By means of what is proposed, a number of carbon fiber hoses can be fitted inside a hose made of aluminum oxide, with the result that a hybrid is obtained which solves the problem concerning the dark color of the carbon fiber. The core of carbon fiber can be responsible for providing the good physical properties, and the aluminum oxide fiber covers the dark color of the carbon fiber and increases the stiffness of the construction, when so desired. Another fiber which can be used correspondingly is the para-aramid fiber sold under the trade name KEVLAR® or TWARON®. This fiber is more yellow in color, which is preferable to the dark

color of the carbon fiber. Said para-aramid fibers can be used if one accepts moisture absorption of up to ca. 3%. If lower moisture absorption levels, for example 0.1%, are required, aluminum oxide fibers can be used.

5

A presently proposed embodiment of an arrangement and a system according to the invention will be described below with reference to the attached drawings, in which

10 Figure 1 shows a front view of a replacement component in the form of a dental bridge fitted to an upper jaw and provided with a reinforcing element, and showing its set of teeth in relation to the teeth of a lower jaw,

15

Figure 2 shows a top view of the extent of the reinforcing element in the replacement component according to Figure 1,

20 Figure 3 shows a cross section through a reinforcing element consisting of an inner core of carbon fiber and a tube surrounding the core and made of a second fiber material,

25 Figure 4 shows the reinforcing element according to Figure 3 in longitudinal section,

Figure 5 shows a cross section through an inner layer of carbon fiber material, and a part made of a second fiber material partially covering the inner layer,

30

Figure 6 shows a front view of a replacement component comprising a tooth preparation with reinforcing element, and

35

Figure 7 is a flow chart showing the various steps in the production of a replacement component.

In Figure 1, a patient is indicated symbolically by 1. The patient's upper jaw 2 is provided with a replacement component in the form of a dental bridge 3. The replacement component can be designed in a manner known per se with internal reinforcing element 4 and set of teeth 5. In Figure 1, the patient's lower jaw is also indicated symbolically by 6 and the patient still has teeth 7 in the lower jaw.

Figure 2 shows the extent of the reinforcing element 4 in the upper jaw 2. The teeth are likewise indicated symbolically by 5.

Figure 3 shows that the reinforcing element 4 comprises a core 8 of carbon fiber and a tube 9 which surrounds the core and is made of a second fiber material which may be aluminum oxide or para-aramid. The diameter of the reinforcing element is indicated by  $D$ , and the diameter of the core is indicated by  $D_1$ . The additional fiber layer 9 has a thickness  $t$  which is substantially less than the diameter  $D_1$ . The thickness  $t$  can, for example, be 1-5% of the diameter  $D_1$ .

The carbon fiber can, in a manner known per se, be made up of carbon fiber wires inlaid from the outset in carbon fiber hoses. The additional fiber 9 thus forms a hose for the carbon fiber wires or carbon fiber hoses surrounding these. The surrounding hose 9 has been provided with hardening agent which has the effect that the carbon fiber wires and the carbon fiber hoses are held firmly together in connection with polymerization. The formation of a homogeneous carbon fiber core can be effected in accordance with the literature references mentioned in the introduction and will therefore not be described in any detail here. Instead of a described tube which is removed after the polymerization, use is thus made of the additional fiber material, which is therefore retained on the finished reinforcing element.

Figure 5 shows an illustrative embodiment in which the core 8' is only partially covered by the additional fiber material 9'. In connection with this embodiment, it is possible to turn that part of the reinforcing element covered with the fiber material 9' to face the outside of the replacement component.

Figure 6 shows a tooth preparation which can use a reinforcing element according to the invention. In this case, the tooth preparation comprises only one tooth and is indicated symbolically by 10. The patient's upper jaw is indicated symbolically by 2', and the reinforcing element by 4', while the tooth in question is indicated symbolically by 5'.

In Figure 7, the patient is indicated by 11. The patient is to receive a dental bridge in the upper jaw and still has teeth 12 in his lower jaw. Identification equipment is indicated by 13 and, with the aid of this identification equipment, the treatment situation on the patient can be identified. This identification can be done in a manner known per se using different equipment, instruments and aids. Information 14 relating to the result of the identification can be transmitted to computer equipment 15 which is provided with a screen 15a and operating member (e.g. keyboard) 15b. The computer equipment is intended, in a manner known per se, to provide a visual image of the treatment situation as a function of the received information 14 and to add modifications to this image via the operating member 15b. In this way, a visual image 16 of the replacement component/dental bridge can be obtained. The fitting of the reinforcing element is indicated symbolically by 17 in Figure 7. As a function of the visual structure on the computer 15, information 18, 19 concerning this can be transmitted to manually operated equipment 20 (at a dental technician) and/or to fully automated production equipment for dental products, for example production equipment of the

PROCERA® type. If the information from the computer equipment is received in the equipment 20, the reinforcing element 17', 17'' can be produced and the dental bridge or replacement component 16' finished.

5 Correspondingly, said production of reinforcing element and dental bridge can be carried out in the fully automated equipment 21. Alternatively, cooperation is also possible between the units 20 and 21, as has been symbolized by arrow 22 pointing in two directions. The

10 equipment 21 can also be in two-way communication with the computer equipment, see 19, and the identification equipment, see arrows 23. In connection with the production in the equipment 20 and/or equipment 21, the replacement component can be produced on the basis of

15 empirical data. In this respect it may be mentioned that information can be obtained concerning the core and the fiber covering it. Such information can include details of diameters, thicknesses, qualities, colors, relations between diameters and thicknesses for the

20 situation in question. The color chosen for the additional fiber material can be white (or substantially white) or can have a yellow shade. Information on the moisture absorption to be present in the particular case of treatment can also be received.

25 In Figure 7, a user of the computer equipment is indicated symbolically by 24.

The present invention is not limited to the illustrative embodiment described above, and instead it

30 can be modified within the scope of the attached patent claims and the inventive concept.

The computer equipment and identification equipment, which can be of known types, operate with conventional

35 computer programs and file management.